

WHAT IS CLAIMED IS:

5

1. A pixel clock generation apparatus,
comprising:

a detector detecting a time interval between
two horizontal synchronization signals;

10 a comparing part comparing the time interval
detected by said detector and a target value, and
outputting a difference therebetween;

a phase shift data generation part having a
lookup table storing a pattern of phase shift data for
15 controlling a phase shift amount of a pixel clock, and
reading and outputting the phase shift data from the
lookup table based on the difference that is output from
said comparing part;

a high frequency clock generation part
20 generating a high frequency clock; and

a pixel clock generation part generating the
pixel clock whose phase is controlled in accordance with
the phase shift data that are output from said phase
shift data generating part based on the high frequency
25 clock that is generated by said high frequency clock

generating part.

5

2. The pixel clock generation apparatus as
claimed in claim 1, wherein phase control of the pixel
clock is performed on each data area, where one data
area is formed by a plurality of consecutive pixel
10 clocks.

15

3. The pixel clock generation apparatus as
claimed in claim 1, wherein the phase shift data
generating part stores a plurality of the lookup tables,
and the lookup tables from which the phase shift data
are read are switched within one scan line period.

20

4. The pixel clock generation apparatus as
25 claimed in claim 1, wherein the pixel clocks subjected

to phase shift are spaced substantially equally.

5

5. The pixel clock generation apparatus as
claimed in claim 4, wherein the phase shift data
generation part includes a unit that sets an interval
between the pixel clocks subjected to the phase shift to
10 a value obtained by multiplying a reference value by a
multiplying factor for correction corresponding to a
resolution.

15

6. The pixel clock generation apparatus as
claimed in claim 1, wherein the pixel clocks subjected
to phase shift are spaced unequally.

20

7. The pixel clock generation apparatus as
25 claimed in claim 1, wherein, in an image height region

having a great variation of a main scan dot position shift, an interval between the pixel clocks subjected to phase shift is decreased compared to in an image height region having a small variation of the main scan dot position shift.

10 8. The pixel clock generation apparatus as claimed in claim 1, wherein the phase shift data generation part switches, for each scan line, a plurality of the lookup tables from which the phase shift data are read.

15

 9. The pixel clock generation apparatus as
20 claimed in claim 1, wherein, when there are consecutive scan lines to which the phase shift data of an identical pattern are output, the phase shift data generation part varies the pattern of the phase shift data.

25

10. The pixel clock generation apparatus as
claimed in claim 1, wherein, when there are consecutive
5 scan lines to which the phase shift data of an identical
pattern are output, the phase shift data generation part
varies the pattern of the phase shift data by switching
a plurality of the lookup tables.

10

11. The pixel clock generation apparatus as
claimed in claim 10, wherein a pattern of the phase
15 shift data after the switching of the lookup tables is
such that the pixel clock in a substantially middle
position of the pixel clocks subjected to phase shift by
a pattern of the phase shift data before the switching
of the lookup tables is subjected to phase shift.

20

12. The pixel clock generation apparatus as
25 claimed in claim 10, wherein a pattern of the phase

shift data after the switching of the lookup tables is
such that the pixel clock at a position that is shifted
for a constant number of clocks from the pixel clock
subjected to phase shift in a pattern of the phase shift
5 data before the switching of the lookup tables is
subjected to phase shift.

10

13. The pixel clock generation apparatus as
claimed in claim 10, wherein, when there are N ($N \geq 2$)
consecutive scan lines to which the phase shift data of
an identical pattern are output, the phase shift data
15 generation part varies the pattern of the phase shift
data by switching the lookup tables in the next scan
line.

20

14. The pixel clock generation apparatus as
claimed in claim 10, wherein the switching of the lookup
tables in a case where there are the consecutive scan
25 lines to which the phase shift data of an identical

pattern is output is performed only in an effective scan region of the scan line where image forming is performed.

5

15. A pixel clock generation apparatus,
comprising:

10 a detector detecting a time interval between
each two adjacent horizontal synchronization signals
among three or more of the horizontal synchronization
signals;

a comparing part comparing each time interval
detected by said detector with a target value and
15 outputting each difference therebetween;

a phase shift data generation part having at
least one lookup table storing a pattern of phase shift
data for controlling a phase shift amount of a pixel
clock, and reading and outputting the phase shift data
20 from the lookup table based on each difference that is
output from said comparing part;

a high frequency clock generation part
generating a high frequency clock; and

a pixel clock generation part generating a
25 pixel clock whose phase is controlled in accordance with

the phase shift data that are output from said phase shift data generating part based on the high frequency clock that is generated by said high frequency clock generating part.

5

16. The pixel clock generation apparatus as claimed in claim 15, wherein phase control of the pixel clock is performed on each data area, where one data area is formed by a plurality of consecutive pixel clocks.

15

17. The pixel clock generation apparatus as claimed in claim 15, wherein the phase shift data generating part stores a plurality of the lookup tables, and the lookup tables from which the phase shift data are read are switched within one scan line period.

25

18. The pixel clock generation apparatus as claimed in claim 15, wherein the pixel clocks subjected to phase shift are spaced substantially equally.

5

19. The pixel clock generation apparatus as claimed in claim 18, wherein the phase shift data generation part includes a unit that sets an interval between the pixel clocks subjected to the phase shift to a value obtained by multiplying a reference value by a multiplying factor for correction corresponding to a resolution.

15

20. The pixel clock generation apparatus as claimed in claim 15, wherein the pixel clocks subjected to phase shift are spaced unequally.

20

25

21. The pixel clock generation apparatus as
claimed in claim 15, wherein, in an image height region
having a great variation of a main scan dot position
5 shift, an interval between the pixel clocks subjected to
phase shift is decreased compared to in an image height
region having a small variation of the main scan dot
position shift.

10

22. The pixel clock generation apparatus as
claimed in claim 15, wherein the phase shift data
15 generation part switches, for each scan line, a
plurality of the lookup tables from which the phase
shift data are read.

20

23. The pixel clock generation apparatus as
claimed in claim 15, wherein, when there are consecutive
scan lines to which the phase shift data of an identical
25 pattern are output, the phase shift data generation part

varies the pattern of the phase shift data.

5

24. The pixel clock generation apparatus as claimed in claim 15, wherein, when there are consecutive scan lines to which the phase shift data of an identical pattern are output, the phase shift data generation part
10 varies the pattern of the phase shift data by switching a plurality of the lookup tables.

15

25. The pixel clock generation apparatus as claimed in claim 24, wherein a pattern of the phase shift data after the switching of the lookup tables is such that the pixel clock in a substantially middle
20 position of the pixel clocks subjected to phase shift by a pattern of the phase shift data before the switching of the lookup tables is subjected to phase shift.

25

26. The pixel clock generation apparatus as
claimed in claim 24, wherein a pattern of the phase
shift data after the switching of the lookup tables is
5 such that a pixel clock at a position that is shifted
for a constant number of clocks from a pixel clock
subjected to phase shift in a pattern of the phase shift
data before the switching of the lookup tables is
subjected to the phase shift.

10

27. The pixel clock generation apparatus as
15 claimed in claim 24, wherein, when there are N ($N \geq 2$)
consecutive scan lines to which the phase shift data of
an identical pattern are output, the phase shift data
generation part varies the pattern of the phase shift
data by switching the lookup tables in the next scan
20 line.

25 28. The pixel clock generation apparatus as

claimed in claim 24, wherein the switching of the lookup
tables in a case where there are the consecutive scan
lines to which the phase shift data of an identical
pattern is output is performed only in an effective scan
5 region of the scan line where image forming is performed.

10 29. A pixel clock generation method,
comprising the steps of:
 detecting a time interval between two
horizontal synchronization signals;
 reading phase shift data from a lookup table
15 based on a difference between the detected time interval
and a target value; and
 controlling phase of a pixel clock in
accordance with the phase shift data.

20

 30. A pixel clock generation method,
comprising the steps of:
25 detecting a time interval between each two

adjacent horizontal synchronization signals among three
or more of the horizontal synchronization signals;

reading phase shift data from a lookup table
based on each difference between the detected time
5 interval and a target value; and

controlling phase of a pixel clock in
accordance with the phase shift data.

10

31. An image forming apparatus, comprising:

a medium to be scanned;

a light beam source outputting a light beam;

15 a deflecting part deflecting the light beam
output from said light beam source so that the deflected
light beam scans said medium to be scanned and forms an
image on said medium to be scanned;

a pixel clock generation apparatus generating
20 a pixel clock; and

a horizontal synchronization detector
detecting scan timings at which the light beam scans two
or more specific horizontal scan positions, so as to
generate two or more horizontal synchronization signals
25 supplied to said pixel clock generation apparatus,

said pixel clock generation apparatus
including:

a detector detecting a time interval
between two of the horizontal synchronization signals;

5 a comparing part comparing the time
interval detected by said detector and a target value,
and outputting a difference therebetween;

a phase shift data generation part having
a lookup table storing a pattern of phase shift data for
10 controlling a phase shift amount of the pixel clock, and
reading and outputting the phase shift data from the
lookup table based on the difference that is output from
said comparing part;

a high frequency clock generation part
15 generating a high frequency clock; and

a pixel clock generation part generating
the pixel clock whose phase is controlled in accordance
with the phase shift data that are output from said
phase shift data generating part based on the high
20 frequency clock that is generated by said high frequency
clock generating part,

wherein said light beam source is driven in
synchronization with the pixel clock generated by said
pixel clock generation apparatus.

32. The image forming apparatus as claimed in
5 claim 31, wherein the horizontal synchronization
detector consists of a unit separating a part of a
plurality of the light beams deflected by the deflecting
part, and two or more photodetectors receiving the light
beams separated by said unit and arranged at respective
10 positions corresponding to the two or more specific
horizontal scan positions.

15

33. The image forming apparatus as claimed in
claim 31, wherein the horizontal synchronization
detector consists of a unit separating a part of a
plurality of the light beams deflected by the deflecting
20 part, two or more reflecting members arranged at
respective positions corresponding to the specific
horizontal scan positions, the light beams separated by
said unit being incident on said reflecting members, and
a photodetector receiving the light beams reflected by
25 the reflecting members.

5 34. The image forming apparatus as claimed in
claim 31, wherein the horizontal synchronization
detector consists of a unit separating a part of a
plurality of the light beams deflected by the deflecting
part, a reflecting member and one or more
10 reflecting/transmitting members arranged at respective
positions corresponding to the specific horizontal scan
positions, the light beams separated by said unit being
incident on said reflecting member and said one or more
reflecting/transmitting members, and a photodetector
15 receiving the light beams reflected by the reflecting
member and said one or more reflecting/transmitting
members.

20

 35. The image forming apparatus as claimed in
claim 31, wherein the horizontal synchronization
detector consists of a unit separating a part of a
25 plurality of the light beams deflected by the deflecting

part, two or more reflecting/transmitting members
arranged at respective positions corresponding to the
specific horizontal scan positions, the light beams
separated by said unit being incident on said
5 reflecting/transmitting members, and a photodetector
receiving the light beams reflected by said
reflecting/transmitting members.

10

36. The image forming apparatus as claimed in
claim 31, further comprising:

a light beam source for reference,

15 wherein a light beam for reference output from
said light beam source for reference is incident on the
deflecting part, and the light beam for reference
deflected by the deflecting part scans outside of the
medium to be scanned, and

20 wherein the horizontal synchronization
detector consists of two or more photodetectors
receiving the light beam for reference deflected by the
deflecting part, and are arranged at respective
positions corresponding to the specific horizontal scan
25 positions.

5 37. The image forming apparatus as claimed in
claim 31, further comprising:

 a light beam source for reference,

 wherein a light beam for reference output from
said light beam source for reference is incident on the
10 deflecting part, and the light beam for reference
deflected by the deflecting part scans outside of the
medium to be scanned, and

 wherein the horizontal synchronization
detector consists of two or more reflecting members
15 arranged at respective positions corresponding to the
specific horizontal scan positions, the light beam for
reference deflected by the deflecting part being
incident on said reflecting members, and a photodetector
receiving the light beam for reference reflected by said
20 more reflecting members.

25 38. An image forming apparatus, comprising:

a medium to be scanned;
a light beam source outputting a light beam;
a deflecting part deflecting the light beam
output from said light beam source so that the deflected
5 light beam scans said medium to be scanned and forms an
image on said medium to be scanned;
a pixel clock generation apparatus generating
a pixel clock; and
a horizontal synchronization detector
10 detecting scan timings at which the light beam scans two
or more specific horizontal scan positions, so as to
generate two or more horizontal synchronization signals
supplied to said pixel clock generation apparatus,
said pixel clock generation apparatus
15 including:
a detector detecting a time interval
between each two adjacent horizontal synchronization
signals among three or more of the horizontal
synchronization signals;
20 a comparing part comparing each time
interval detected by said detector with a target value
and outputting each difference therebetween;
a phase shift data generation part having
one or more lookup tables each storing a pattern of
25 phase shift data for controlling a phase shift amount of

a pixel clock, and reading and outputting the phase shift data from one of the lookups table based on each difference that is output from said comparing part;

a high frequency clock generation part.

5 generating a high frequency clock; and

a pixel clock generation part generating a pixel clock whose phase is controlled in accordance with the phase shift data that are output from said phase shift data generating part based on the high
10 frequency clock that is generated by said high frequency clock generating part,

wherein said light beam source is driven in synchronization with the pixel clock generated by said pixel clock generation apparatus.

15

39. The image forming apparatus as claimed in
20 claim 38, wherein the horizontal synchronization detector consists of a unit separating a part of a plurality of the light beams deflected by the deflecting part, and two or more photodetectors receiving the light beams separated by said unit and arranged at respective
25 positions corresponding to the specific horizontal scan

positions.

5

40. The image forming apparatus as claimed in claim 38, wherein the horizontal synchronization detector consists of a unit separating a part of a plurality of the light beams deflected by the deflecting part, two or more reflecting members arranged at
10 respective positions corresponding to the specific horizontal scan positions, the light beams separated by said unit being incident on said reflecting members, and a photodetector receiving the light beams reflected by
15 the reflecting members.

20

41. The image forming apparatus as claimed in claim 38, wherein the horizontal synchronization detector consists of a unit separating a part of a plurality of the light beams deflected by the deflecting part, a reflecting member and one or more
25 reflecting/transmitting members arranged at respective

positions corresponding to the specific horizontal scan positions, the light beams separated by said unit being incident on said reflecting member and said one or more reflecting/transmitting members, and a photodetector
5 receiving the light beams reflected by the reflecting member and said one or more reflecting/transmitting members.

10

42. The image forming apparatus as claimed in claim 38, wherein the horizontal synchronization detector consists of a unit separating a part of a
15 plurality of the light beams deflected by the deflecting part, two or more reflecting/transmitting members arranged at respective positions corresponding to the specific horizontal scan positions, the light beams separated by said unit being incident on said
20 reflecting/transmitting members, and a photodetector receiving the light beams reflected by said reflecting/transmitting members.

25

43. The image forming apparatus as claimed in claim 38, further comprising:

a light beam source for reference,

5 wherein a light beam for reference output from said light beam source for reference is incident on the deflecting part, and the light beam for reference deflected by the deflecting part scans outside of the medium to be scanned, and

10 wherein the horizontal synchronization detector consists of two or more photodetectors receiving the light beam for reference deflected by the deflecting part, and are arranged at respective positions corresponding to the specific horizontal scan
15 positions.

20 44. The image forming apparatus as claimed in claim 38, further comprising:

a light beam source for reference,

wherein a light beam for reference output from said light beam source for reference is incident on the
25 deflecting part, and the light beam for reference

deflected by the deflecting part scans outside of the medium to be scanned, and

wherein the horizontal synchronization detector consists of two or more reflecting members arranged at respective positions corresponding to the specific horizontal scan positions, the light beam for reference deflected by the deflecting part being incident on said reflecting members, and a photodetector receiving the light beam for reference reflected by said reflecting members.

45. A tandem-type image forming apparatus, comprising:

a plurality of color stations corresponding to respective colors, each including a light beam source for image writing, a pixel clock generation apparatus, and a horizontal synchronization detector for generating two or more horizontal synchronization signals supplied to said pixel clock generation apparatus,

said pixel clock generation apparatus including:

a detector detecting a time interval

between two of the horizontal synchronization signals;

a comparing part comparing the time interval detected by said detector and a target value, and outputting a difference therebetween;

5 a phase shift data generation part having a lookup table storing a pattern of phase shift data for controlling a phase shift amount of a pixel clock, and reading and outputting the phase shift data from the lookup table based on the difference that is output from
10 said comparing part;

a high frequency clock generation part generating a high frequency clock; and

a pixel clock generation part generating the pixel clock whose phase is controlled in accordance
15 with the phase shift data that are output from said phase shift data generating part based on the high frequency clock that is generated by said high frequency clock generating part,

wherein, in each of the color stations, said
20 light beam source for image writing is driven in synchronization with the pixel clock generated by the pixel clock generation apparatus corresponding to the color station.

46. A tandem-type image forming apparatus,
comprising:

5 a plurality of color stations corresponding to
respective colors, each including a light beam source
for image writing, a pixel clock generation apparatus,
and a horizontal synchronization detector for generating
two or more horizontal synchronization signals supplied
10 to said pixel clock generation apparatus,

 said pixel clock generation apparatus
including:

 a detector detecting a time interval
between each two adjacent horizontal synchronization
15 signals among three or more of the horizontal
synchronization signals;

 a comparing part comparing each time
interval detected by said detector with a target value
and outputting each difference therebetween;

20 a phase shift data generation part having
one or more lookup tables each storing a pattern of
phase shift data for controlling a phase shift amount of
a pixel clock, and reading and outputting the phase
shift data from one of the lookup tables based on each
25 difference that is output from said comparing part;

a high frequency clock generation part
generating a high frequency clock; and

a pixel clock generation part generating
a pixel clock whose phase is controlled in accordance
5 with the phase shift data that are output from said
phase shift data generating part based on the high
frequency clock that is generated by said high frequency
clock generating part,

wherein, in each of the color stations, said
10 light beam source for image writing is driven in
synchronization with the pixel clock generated by the
pixel clock generation apparatus corresponding to the
color station.